

US EPA ARCHIVE DOCUMENT

Virginia's Nonpoint Source Pollution (NPS) Management Program has long recognized the need to improve surface and ground water quality by reducing nonpoint source pollution associated with abandoned and orphaned mineral mines. Virginia's Department of Conservation and Recreation's Division of Soil and Water (VDCRSW), which administer the NPS program, recently had the unique opportunity to partner with the Virginia Department of Mining, Minerals and Energy's (VDMME) Orphaned Lands Program to support several innovative reclamation projects in order to achieve these water quality goals.

## **Toncrae Mine Orphaned Land Project**

The first project involved reclaiming Toncrae Mine, an abandoned copper mine dating back to the late 1700's. Located in southern Floyd County, Toncrae Mine operated intermittently from the late 1700's to 1947. Operations at the mine included smelters, tailing ponds, and copper and sulfuric acid processing sites. The abandoned mine had severely degraded East Prong Creek with acid mine drainage and heavy metal contamination. Barren mine tailings, underground seeps, open mine shafts, and old ore processing areas contributed to the deposition of large concentrations of heavy metals into the creek, a tributary of the Little River. At one bog site where acid was made, copper was measured at levels thousands of times greater than the limits set by the USEPA.

Local residents described the glimmering metallic water seeping from the site as '...the prettiest thing you ever saw, like a carpet. It killed everything it touched.' In fact, zinc and copper leachates from the abandoned mine had contaminated both the groundwater and decimated the aquatic community within East Prong Creek for at least half a mile downstream of the site. In addition, upland areas surrounding the mine were barren of vegetation due to contaminated and inhospitable soil conditions. Reclamation of the Toncrae Mine site was considered a high priority due to the excessive pollutant levels, the numerous open mine shafts, and perhaps most importantly, the high potential for successful recovery of the site.

### **Phase I**

Phase I of the reclamation included diverting unpolluted waters away from the mine site to limit effluent discharge, sealing of all mine shafts, regrading mine spoil materials, constructing wetlands to treat mine seepage, and revegetating all disturbed areas with tolerant grasses and legume species. The project was begun in October of 1993 and reclamation work was completed in June of 1994. Sixteen shafts were capped, sealed, and mine markers installed. Chemical and invertebrate monitoring of the site began prior to reclamation activities and was continued for two years in order to quantify success of the project.

The innovative wetland system designed to naturally filter out the heavy metals before reaching the surface waters of East Prong Creek is particularly notable. Contaminated discharge from 16 shafts and 6 spoils dumps were routed through 6 cells of constructed wetland, 5 of which filter the 5-7 GPM drainage through bark and straw mulch, then limestone, before discharging into the next cell. Within the cells anaerobic sulfate-reducing bacteria remove toxic heavy metals, while cattails, reeds and other wetland plant species also contribute to metal uptake, and provide a future source of nutrients for the bacteria. The treated water is finally discharged into East Prong Creek.

These man-made wetlands provide a low maintenance and natural way of cleansing polluted waters. The results from this project will boost understanding of the role of constructed wetlands in ecosystem reclamation. Wetlands such as these are seeing increased use in mined land reclamation and the VDMME Division of Mined Land Reclamation is adapting this project to its work on abandoned coal mines. In addition, the US Bureau of Mines is transferring the technology to other problem sites in the nation.

## **Monitoring**

A major goal of the Toncrae Mine Orphaned Land Project was a full restoration of East Prong Creek to a functioning trout stream. Water quality enhancement and recovery of the aquatic invertebrate community that trout rely upon are first steps in achieving that goal. Virginia Polytechnic Institute and State University's Biology Department was contracted to do invertebrate sampling within the creek and chemical monitoring of the constructed wetland cells, both before and after reclamation. Invertebrate sampling conducted prior to reclamation showed the invertebrate population of East Prong Creek to be severely impacted below the Toncrae Mine site. Both the number of species and the total number of organisms were significantly lower than those recorded at a reference site located upstream of the mine and its toxic effluent.

Water quality and invertebrate sampling post-reclamation clearly indicated that the completed project had a significant positive impact on East Prong Stream. Copper levels were appreciably reduced and the invertebrate community showed signs of a rapid recovery. Within months of project completion, both the number of invertebrate taxa and the number of individuals were approaching reference site conditions. In addition, leaf decomposition rates within the stream verified the results of the invertebrate sampling. Some insects rely heavily on leaf litter deposited in the stream as a primary food supply. These insects are an important component of a healthy stream community and as their numbers increase so do the rates of leaf decomposition in the stream.

## **Phase II**

Phase II of the Toncrae Mine Orphaned Mine Land Project was initiated in 1997 in response to continued chemical monitoring of the constructed wetlands. Monitoring results indicated that two of the wetland cells were not functioning as well as desired in the winter months. The goal of phase two was to reconfigure the wetland design to increase detention time and improve performance. This phase of the project also included continued chemical monitoring to quantify success.

The reconfiguration of the constructed wetlands was required due to the drainage being oxygenated too rapidly in the winter months because of higher than expected flows, combined with cooler temperatures. This situation led to the system being unable to maintain the anaerobic conditions required by the sulfate reducing bacteria to adequately break down the metals in solution. The first step of phase II involved increasing the size of the two problem cells. The effect was to create one large wetland cell from the previous two, thereby increasing detention time and the overall time the drainage remains in an anaerobic state. Next, another much larger wetland cell was constructed below the existing cells to further increase detention time. Finally, an anoxic drain was installed to reduce oxygen levels entering the system and assist the wetlands in functioning in an anaerobic state.

Phase II was implemented in the spring of 1997, and monitoring continued through 1998. Chemical monitoring of the wetlands indicated that since reconfiguration, the wetlands are successfully removing metals even in the cooler temperatures of fall and winter.

### **Project Highlights**

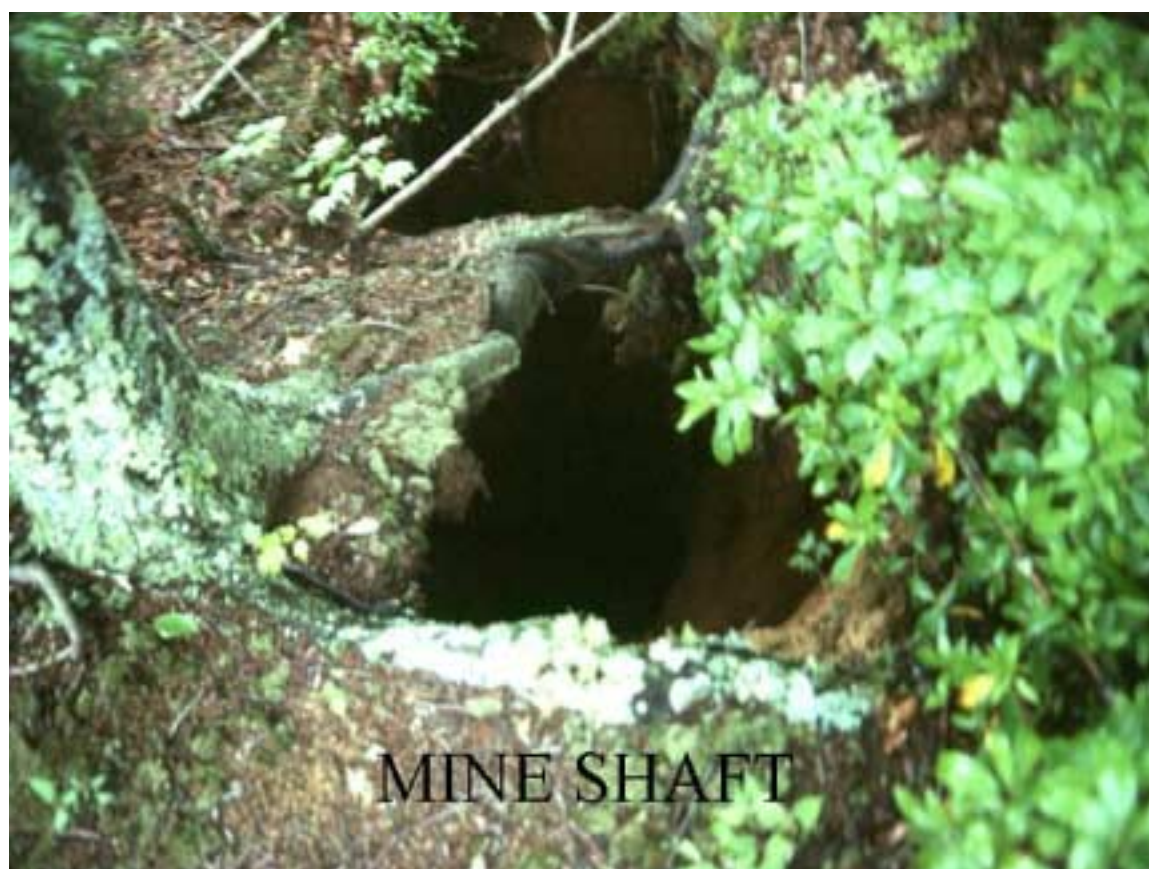
The success of this project led the Virginia Wildlife Federation to Award its 1995 **Mineral Conservationist of the Year Award** to VDMME's Division of Mineral Mining. The award was granted for the successful rehabilitation of the Toncrae Mine Site and East Prong Creek. The nomination for the award notes that 'the creek now has a healthy animal life with growing diversity, and the revegetated land surface is now a camping and picnic ground.'

The long-range goal of the Toncrae Mine Orphaned Land Project was a return of the native brook trout (*Salvalinus fontinalis*) to the contaminated stream section below the mine site. According to residents, no fish had been seen in the contaminated section of East Prong stream in years. Biologists with the Virginia Department of Game and Inland Fisheries (VDGIF) confirmed that brook trout did inhabit the stream above the Toncrae Mine site, but did not occur downstream of the site. However, recent surveys conducted by VDGIF fisheries biologists verify that since reclamation was completed, brook trout have successfully moved into East Prong Creek below the abandoned mine site.

### **Funding**

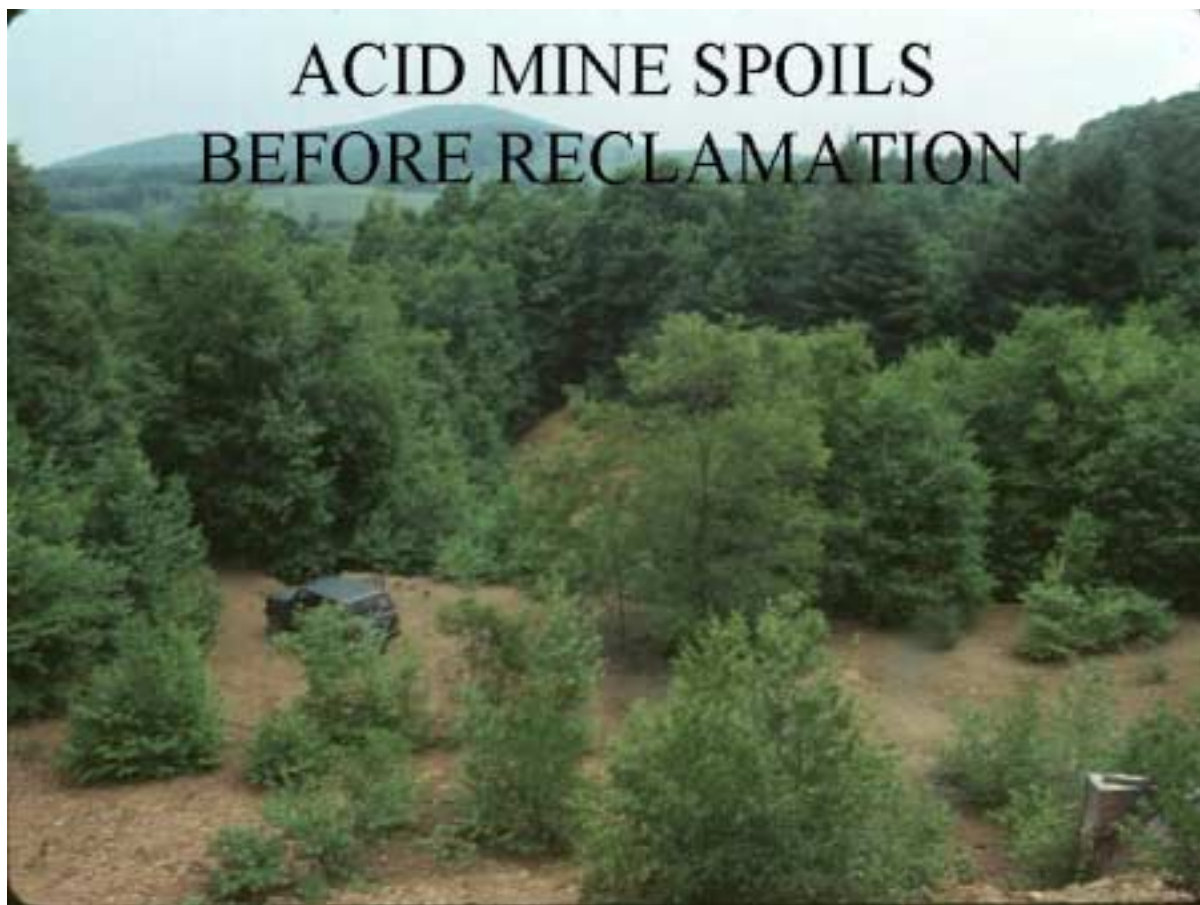
Phase I the 15 acre reclamation project was funded by a \$75,000 federal grant from the Nonpoint Source Pollution Program administered by the Department of Conservation and Recreation's Division of Soil and Water Conservation. The remainder of the \$120,727 reclamation contract was funded through Virginia's Orphaned Land Program administered by the Department of Mines, Minerals and Energy's Division of Mineral Mining. Phase II funding consisted of \$15,000 from NPS funds and \$10,000 from VDMME's Orphaned Land Program. The VDMME's Orphaned Land Program has identified over 3000 abandoned mines other than coal mines since the programs inception in 1978. The inventory program is continuing to identify orphaned mines throughout the Commonwealth, in part with funding from an additional grant from the VDCRSW's Nonpoint Source Management Program.



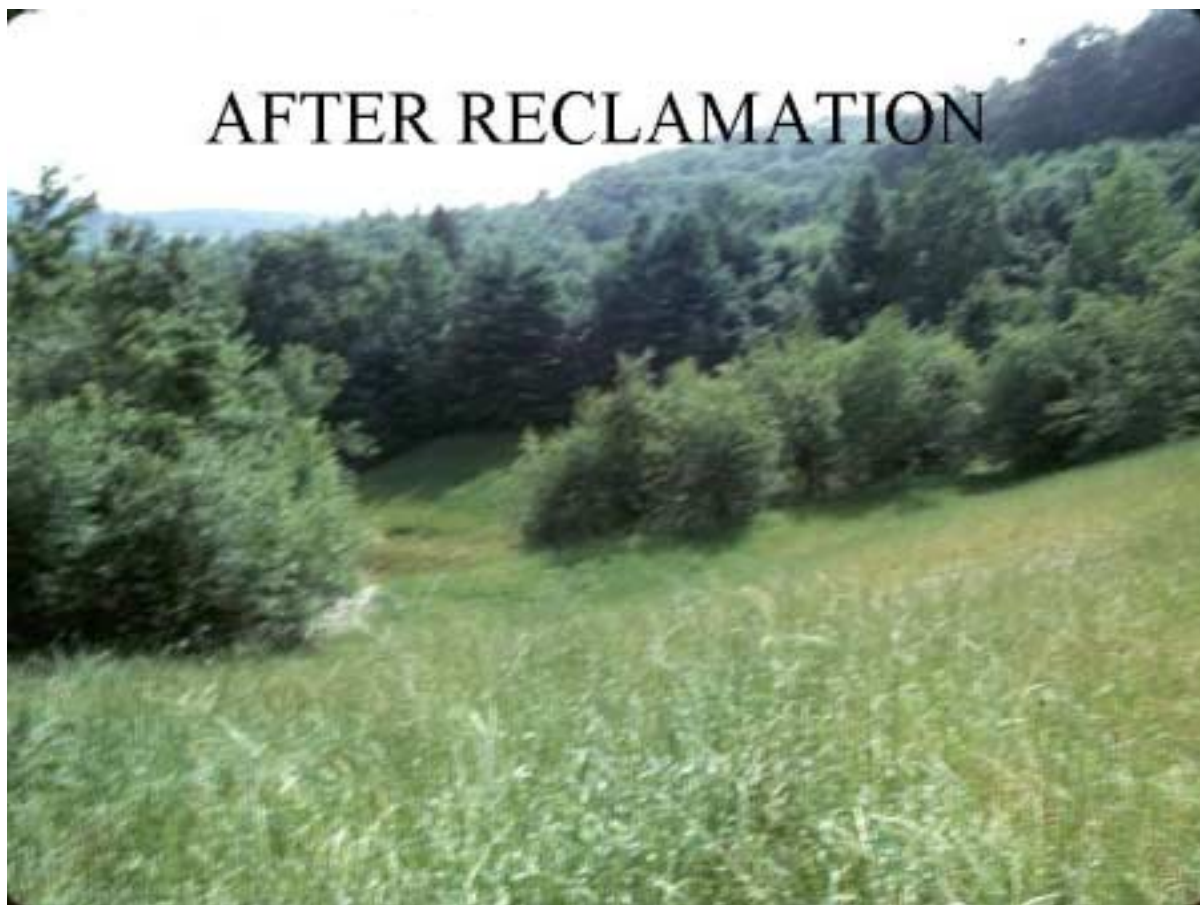


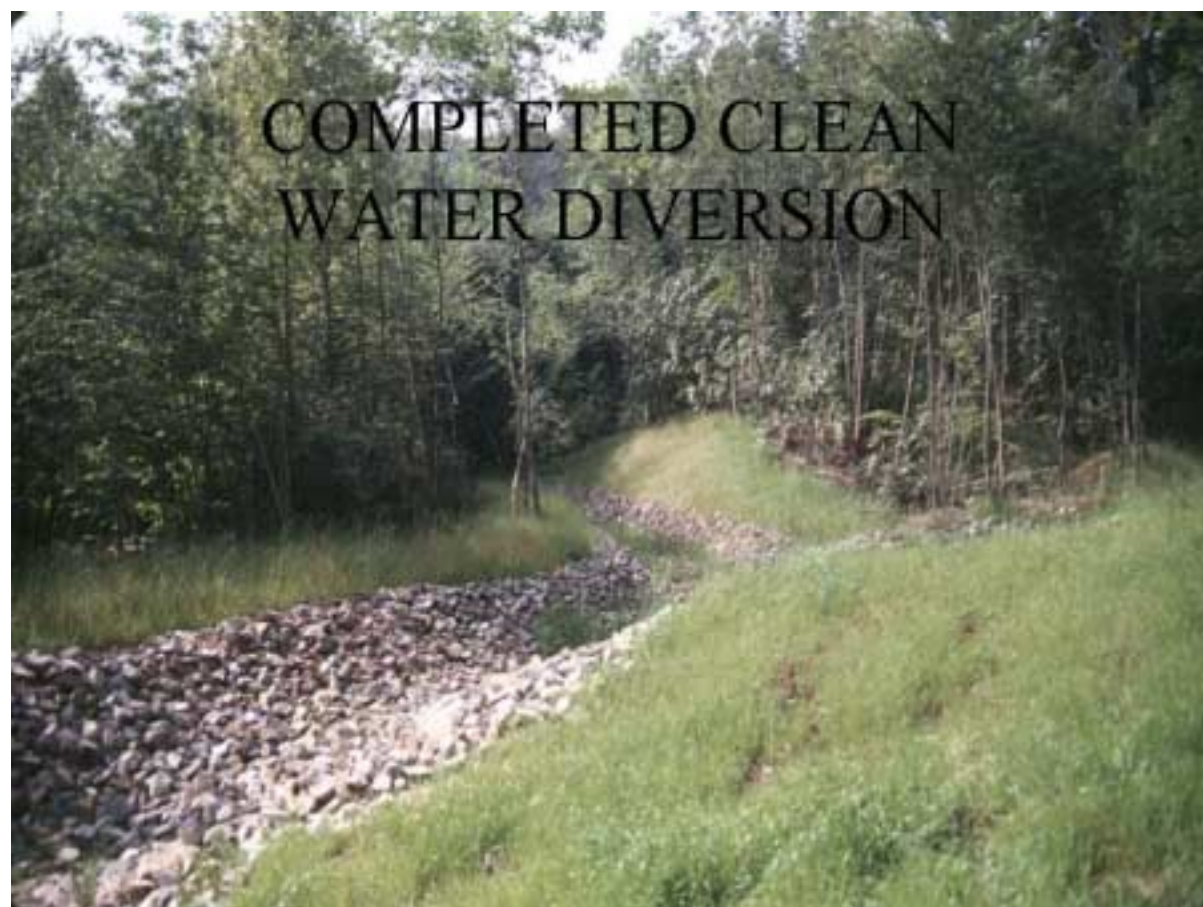


# ACID MINE SPOILS BEFORE RECLAMATION

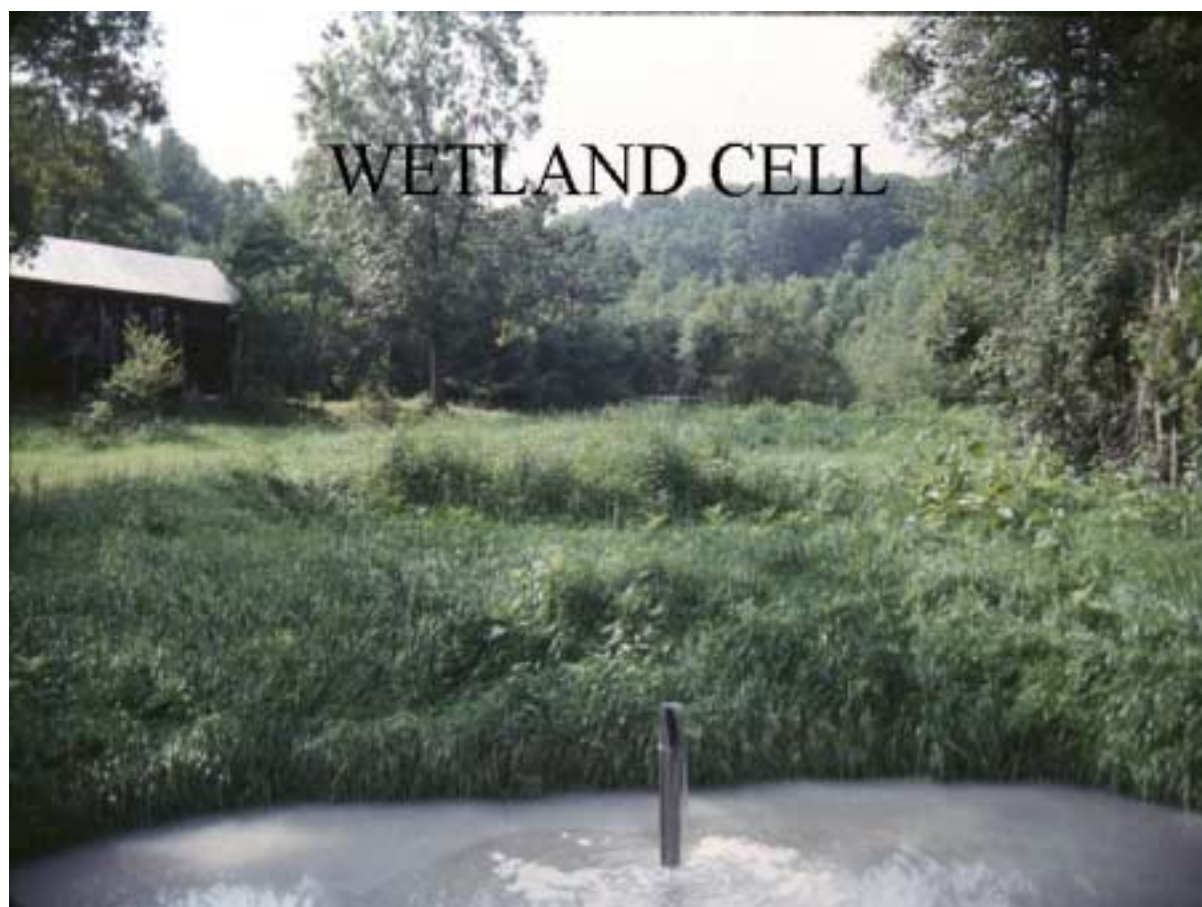
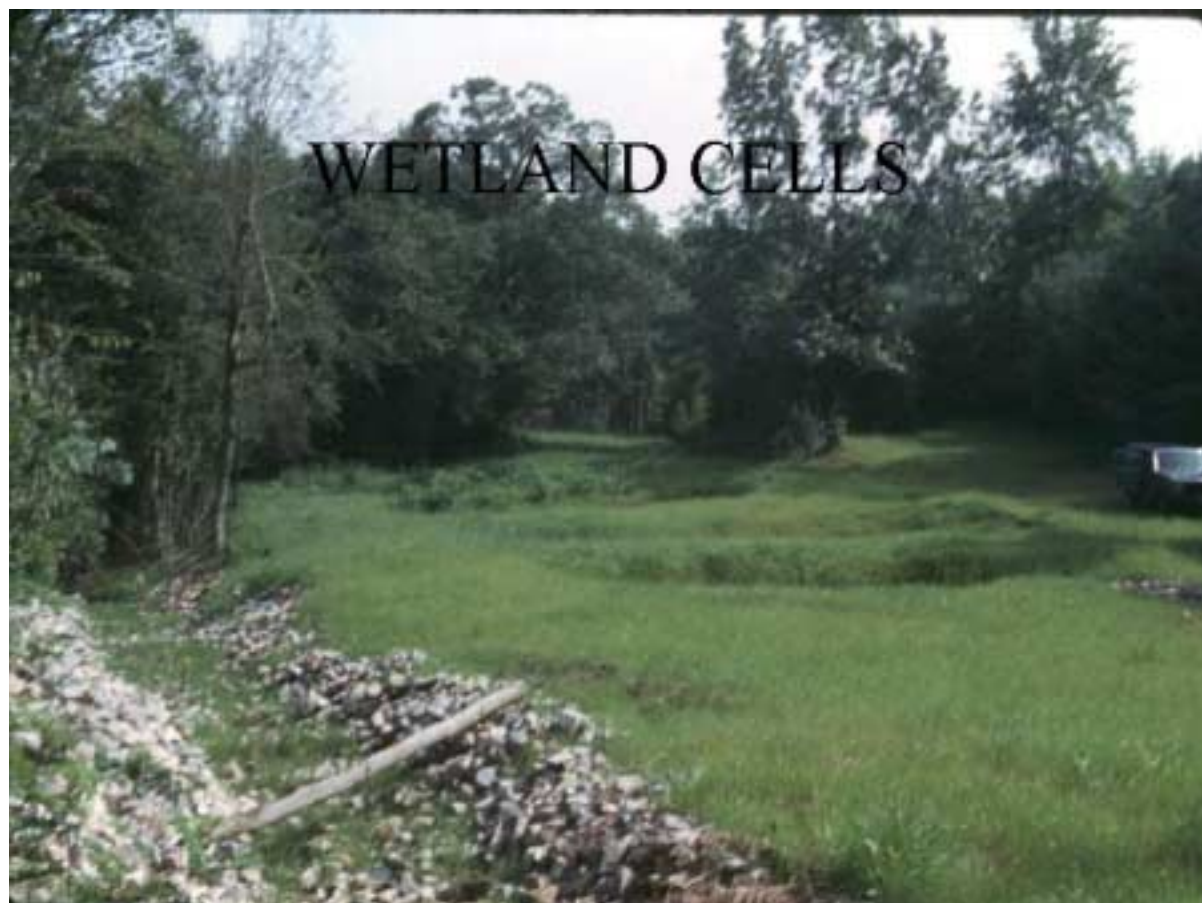


# AFTER RECLAMATION











# VPI & SU MONITORING EAST PRONG CREEK

